

## Chemistry 3420: Physical Chemistry II, Quantum Mechanics

Fall 2009

MWF 9:00 to 10:50, Olin 203, Wed 1– 4:00, Olin 105 & 122

**Professor:** Dr. Lee Lewis  
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**Text:** Physical Chemistry, 8<sup>th</sup> Edition, by Peter Atkins

There is a Student Solutions Manual for this book that may be useful.

Physical Chemistry, 1<sup>st</sup> Edition, by Joseph H. Noggle; Physical Chemistry, 1<sup>st</sup> Edition, by Peter Atkins; and Physical Chemistry, 2<sup>nd</sup> Edition, by Robert Alberty and Robert Silbey are in the library and may prove helpful. I have numerous other physical chemistry texts in my office that you may examine while you are in the near vicinity.

This course uses mathematics extensively. Atkin's textbook has good appendices on various mathematical exercises. Other mathematical aids that are good include Basic Mathematics for Chemists by Peter Tebbutt; Mathematics for Chemistry and Physics by George Turrell; and Mathematics for Physical Chemistry, 2<sup>nd</sup> Edition, by Robert G. Mortimer. (These titles are available to order on-line at various websites, and you're welcome to examine my copies.)

**Note to Students:** Physical chemistry is an exciting subject to study and has a long and varied history. Many famous scientists struggled for decades with the concepts that we will cover in a semester. This will be a difficult course, but we will have fun learning about it. And, I will do all I can to help you learn. A word of caution: Study a little bit every day working problems every day instead of trying to cram in all of your studying at one time. It's easier to absorb the concepts and easier not to get behind if you study in this manner.

**Requirements:** Each student must familiarize himself/herself with available computer facilities in order to access the World Wide Web as well as personal email accounts. There are very good web and computer resources for this class that will enhance and help your classroom and lab experience. Each student must check email periodically in order to receive class announcements, assignments, and test/quiz/homework aids. (See "Computer Resources" within this handout for further information.)

**Objectives:** This course presents the physics and mathematics that is the basis for chemical phenomena. The student will learn to take concepts from the various areas of physical chemistry and assimilate and apply them in solving problems of practical chemical systems. Lab incorporates hands-on experiments that reinforce concepts learned in class.

**Attendance:** Attendance is mandatory for this class. Two unexcused absences are permitted. After two absences, the student's grade will be affected (see "Grading" criteria).  
**Lab:** Absences are not allowed.

**Note:** Disabilities. It is the responsibility of any student with a disability or disabilities to 1) contact Patrick Cooper to register for disability services (You can reach him via e-mail at [coopeap@millsaps.edu](mailto:coopeap@millsaps.edu) or by calling extension 1228. It is school policy that accommodations will not be granted until a meeting with Patrick has taken place each semester and until the appropriate paperwork has been received by the instructor.) and 2) to notify his/her professor **within the first three weeks of the semester**. A request for an appointment with his/her professor is recommended so a viable plan may be developed to meet the special need(s) of the student.

**Grading:** CHEM 3420 consists of a class portion (80 %) and a lab portion (20 %).  
The student's grade will be compiled from the following areas:

<i>Category</i>	Percentage of Final Grade/Important Points
<i>Tests:</i>	48 % (16 % each test) There will be three tests of equal percentage.
<i>Final:</i>	16 % The final will be comprehensive over the course of the semester.
<i>Quizzes:</i>	10 % A short quiz will be given once a week at the beginning of class to gauge the student's understanding of the class material for the time period of one quiz to the next. There will also be ONLY a <b>TEN-minute</b> period for taking the quiz. Since the quiz will be short, there should be no problem completing it in the allotted time.
<i>Class Participation:</i>	6 % Students are expected to be prepared for class by reading ahead and by being prepared to ask questions about what they do not understand and by being prepared to answer questions about what they do understand. Socratic dialogue will be used in class to gauge a student's preparedness. Because of these policies, attendance is mandatory. Two unexcused absences are permitted. After two unexcused absences, the student's grade will be lowered for every subsequent absence. (An unexcused absence consists of a doctor's note in case of sickness, etc.)
<i>Lab:</i>	20 % We will work together on a lab project that simulates real-world research where we propose the project and the experiments necessary to complete the project, perform the experiments, and write up the results as if writing a paper for a journal. Grading Criteria and further lab information are in the file entitled "Syllabus-addendum".

Grades will be assigned according to the following scale:

A	A-	B+	B	B-	C+	C	C-	D+	D	F
94-100	90-93	86-89	83-85	80-82	76-79	73-75	70-72	66-69	60-65	< 60

**Final:** The time designated for CHEM 3420 (MWF classes at 9:00) to take the final exam is Tuesday, December 8, at 9:00 A.M. Any requests for a different exam time must be submitted in writing to the Dean.

**Makeup Policy:** All assignments must be turned in by or before the due date. There are NO EXCEPTIONS. Makeup exams will NOT be given except in the case of extenuating circumstances.

**Grading Errors:** If the student thinks that the instructor has made an error in his/her grade, please submit in writing the reason(s) why the student thinks he/she deserves more credit along with the assignment. This request must be turned in within one week of the assignment having been returned to the student.

**End-of-Class Feedback:** At the end of each class, you are required to submit in writing one concept that you learned during that class period as well as any questions you may still have or any comments about class (e.g. the fact that you didn't quite understand a particular concept or the fact that I consistently hide part of the projection with my shoulder). Do not put your name on these comments to give yourself the freedom to speak clearly about anything in class.

**Computer Resources:** *You must check your email periodically* as I will use the class list email address to send you study hints, clarifications, homework assignments, as well as other material. I will periodically give web addresses for interesting and informative chemistry sites, which are advantageous to the students. This list server also gives the advantage that if a student needs to contact me prior to a test to ask a question, I can answer the student's question while informing the entire class of the answer. Proper etiquette for pre-test questions is to email me directly with the question, and I will then forward the question and answer to the entire class without the name of the student who asked the question.

**Honor Code:** This course operates under the guidelines defined by the Millsaps College Honor Code (see Major Facts, ps. 57-59). Unless otherwise noted, all work turned in for a grade is pledged to be that of said student. It is a violation of the Millsaps Honor Code to obtain help (e.g. human, cyber, textbook, etc.) with any assignment for this class unless given consent by the professor.

The following actions are considered Honor Code violations if they occur during a CHEM 3420 exam: Cell phones are not permitted even to check the time. The student may not leave the room without the professor's consent except in the case of an emergency. After taking an exam, discussion of an exam with other individuals who have not taken the exam is a violation.

**Changes:** Changes to this syllabus are not anticipated. If there are any changes to the course material due to time constraints, they will be announced in class.

**TENTATIVE COURSE OUTLINE**

(These topics may not be covered in this particular order. The topics will be announced in class in a timely fashion for the student to read ahead.)

**Chapters 8 & 9**

**Quantum Theory**

Especially the concepts and practice of particles and waves, atomic theory, operator algebra, the postulates of quantum theory, and the models of the particle-in-a-box and the harmonic oscillator

**Chapter 10**

**Atomic Structure and Atomic Spectra**

Especially the concepts and practice of the hydrogen atom, electron spin, the pauli exclusion principle, many-electron atoms, and atomic spectroscopy

**Chapter 11**

**Molecular Structure**

Especially the concepts and practice of molecular energy, molecular vibration, molecular rotation, molecular orbital theory, and electronic spectroscopy

**Chapters 12, 13, 14, & 15**

**Symmetry and Spectroscopy**

Especially the concepts and practice of symmetry, symmetry operations, groups, bonding theory, the Born-Oppenheimer approximation, selection rules, molecular vibration, and molecular rotation